Idaho State Department of Agriculture
Division of Agricultural Resources

Little Salmon River and Big Creek Water Quality Monitoring Report
April 2004 through October 2004

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ISDA Technical Report Summary W-13 **February 2005**

Introduction

The Idaho State Department of Agriculture (ISDA) with assistance from the Idaho Association of Soil Conservation Districts (IASCD) and the Idaho Department of Environmental Quality (IDEQ) completed a water quality monitoring project on the Little Salmon River (LSR) and Big Creek (BC). The monitoring was conducted by ISDA at the request of the Little Salmon River Watershed Advisory Group (WAG). LSR and BC are both located within Hydrological Unit Code (HUC) 17060210, which encompasses both Adams and Idaho County. Big Creek and LSR are both listed on Idaho's 303(d) list for Total Maximum Daily Load (TMDL) development in 2005. LSR is listed for unknown pollutants while Big Creek is listed for nutrients and sediment.

There were four stations established on the Little Salmon River with the following designations: LSR-1 at Riggins, LSR-2 Whitebird bridge, LSR-3 Circle C bridge, and LSR-4 at Old Highway 95 (Figure 1). We were unable to establish a water quality background site for the Little Salmon River. Stations LSR-1 and LSR-2 were established to evaluate the water quality within the canyon section of the LSR. Stations LSR-3 and LSR-4 were located to help assess water quality in the upper meadow section of the LSR.

Big Creek had 2 monitoring stations with the lower site BC-1 located on Southend road near the confluence with LSR and an upper station (BC-2) approximately 5 river miles upstream on Whitney road.

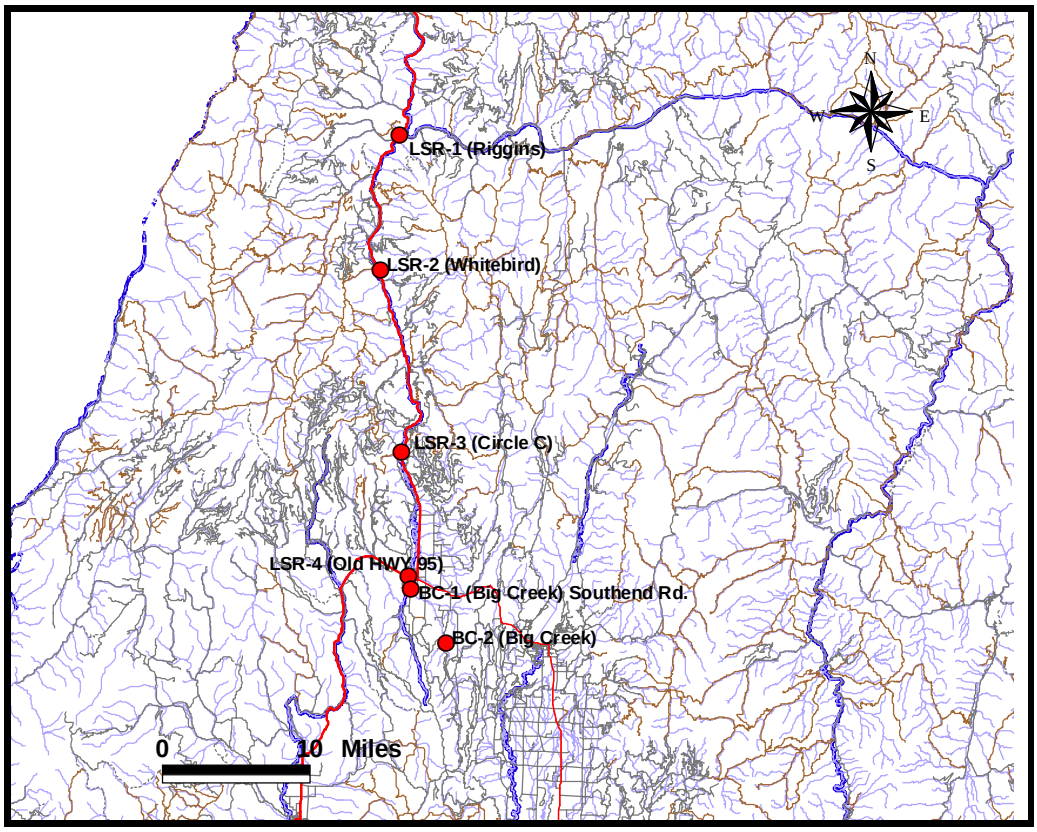

Figure 1. Little Salmon River and Big Creek monitoring sites.

The BC-2 station was established as the background site for Big Creek while the BC-1 site was used to determine nutrient and sediment loading from Big Creek into the LSR.

Monitoring was conducted every 2 weeks from April through October 2004. Analytical parameters collected were suspended sediment concentration (SSC), total phosphorus (TP), dissolved phosphorus (DP), nitrate (NO_3), and Escherichia coli (*E-coli*). On-site parameters measured were dissolved oxygen, percent saturation, pH, total dissolved solids, conductivity, and discharge.

General Results

Suspended Sediment Concentration (SSC)

Suspended sediment samples were collected at all locations to determine if suspended sediment concentrations (SSC) were at unacceptable levels within Big Creek and LSR. Integrated suspended sediment samplers were used to collect the SSC samples. Three sampler models were used, US D-74, US DH-95, or US DH-81, depending on the discharge rate at the monitoring station.

Due to the nature of the sampling schedule (every 2 weeks) there may have been some missed opportunities to evaluate a major sediment runoff event. There were no major peak concentration of SSC collected during this survey (Figure 2 and 3).

The overall SSC concentrations, at all of the monitoring stations, were below any referenced sediment criteria for salmonids. The mean concentrations over the 6 month monitoring period indicated that the long term SSC concentrations were well below any known chronic or acute levels for aquatic species (Table 1).

Table 1. SSC statistics (mg/L).

Statistics	LSR-1	LSR-2	LSR-3	LSR-4	BC-1	BC-2
n	14	15	15	15	13	15
mean	3.0	2.1	2.7	3.5	4.3	1.9
median	2.2	1.3	1.7	3.4	3.4	1.2
minimum	0.7	0.2	0.3	1.8	0.6	0.3
maximum	7.1	5.1	8.4	5.6	8.9	5.6

At no time did any station exceed SSC concentrations of 25 mg/L (DFO 2000) which is considered the minimum threshold concentration for quality fish habitat (Table 2 and Figures 2 and 3).

Table 2. Suspended sediment and fisheries effects.

Suspended Sediment (SS) concentrations (ppm)	Possible Effect on Fisheries
< 25 ppm	No evidence of harmful effects on fish.
25-80 ppm	Possible to maintain good to moderate fisheries however yield would be somewhat diminished relative to water with < 25ppm
80-400 ppm	Unlikely to support good freshwater fisheries.
>400 ppm	At best only poor fisheries are likely to be found.

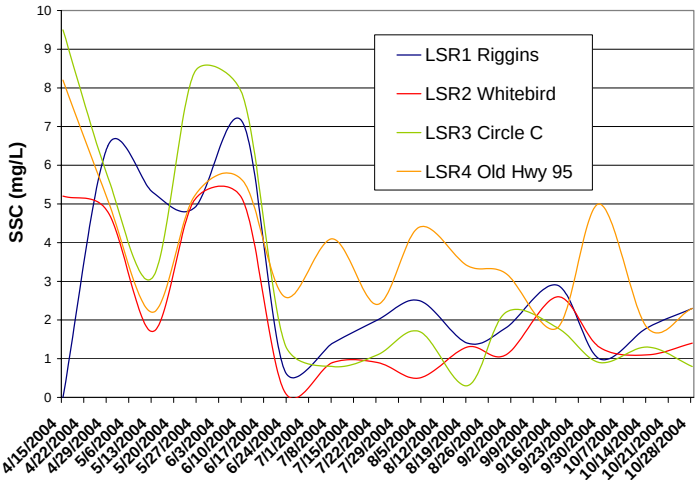

Figure 2. SSC concentration LSR sites.

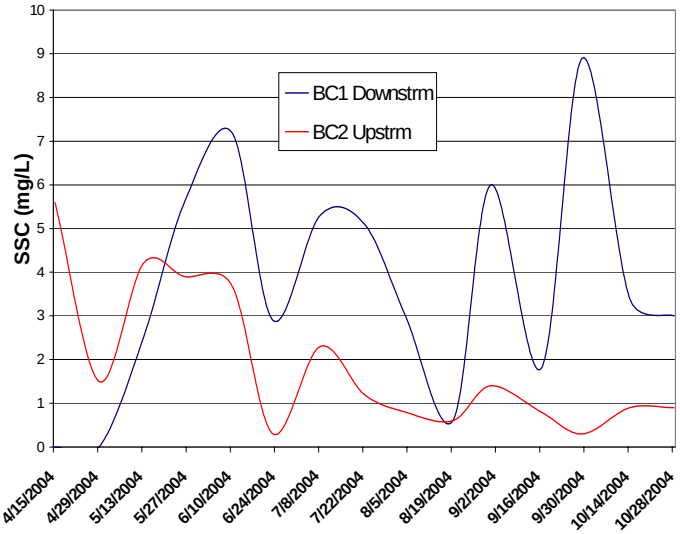

Figure 3. SSC concentration Big Creek

Phosphorus

Phosphorus results indicate that 2 sites (LSR-1 and LSR-2) located in the canyon section of the LSR had no positive detections of phosphorus and the levels were below the analytical detection limit of 0.05 mg/L. The two upper stations (LSR-3 and LSR-4) located within the meadow area of LSR indicate possible nutrient enrichment from phosphorus.

LSR-4 the furthest upstream site at Old Highway 95 had the highest concentrations of TP occur in late July through mid August. Also during the same time period, the TP began consisting on average of approximately 58% DP (Figure 4). The 15 samples collected at LSR-4 had 10 positive detections (≥0.05 mg/L) for TP.

LSR-3 (Circle C) the next station downstream of LSR-4 also showed an increase in TP concentrations starting in late July through the end of August. The peak in concentrations of TP may be a result of excessive algae blooms that slough off from the substrate or detritus material (dead organic material). But unlike LSR-4, it appears that any DP within LSR had been thoroughly metabolized or diluted out by the time the water reached LSR-3 (Figure 4). There were no positive detections of DP at LSR-3. There were only six out of 15 positive detects (≥0.05 mg/L) of TP at LSR-3.

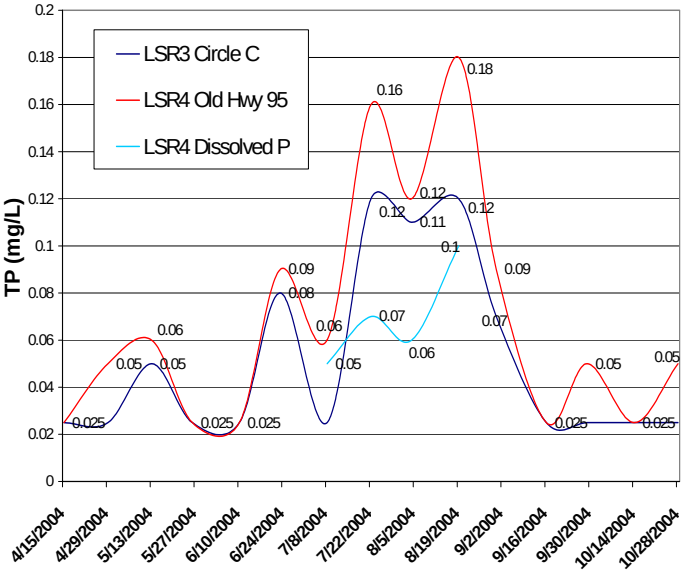

Figure 4. LSR-3 and LSR-4 phosphorus concentrations.

It appears from the data that Big Creek is contributing a phosphorus load into the upper reach of LSR. Starting in May and running through late September the average concentration of TP was 0.10 mg/L. The TP concentration for the last two samplings in October were both below the detection limit (<0.05 mg/L). It appears that during the irrigation season is when Big Creek delivers it largest concentrations of TP. Dissolved phosphorus makes up, on average, 58% of the TP during the period from late June through late August (Figure 5). The DP may be attributable to shallow phosphorus enriched ground water (hyporeic zone) recharging back into Big Creek from irrigation practices.

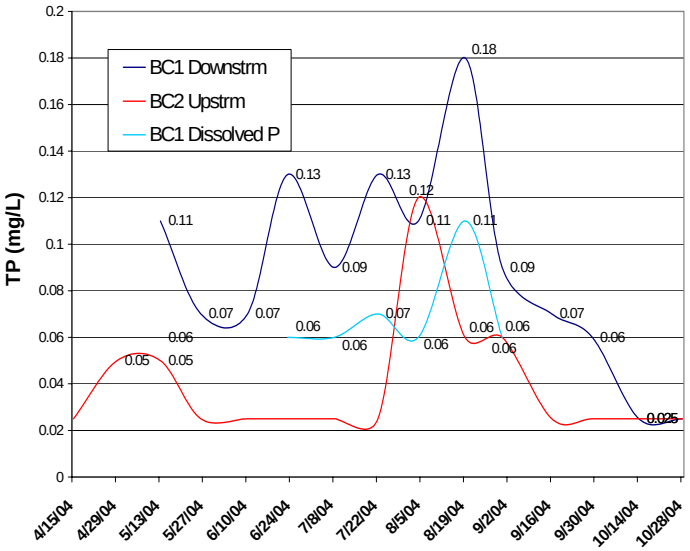

Figure 5. Big Creek phosphorus concentrations.

At both LSR-4 and LSR-3 the peak concentration of TP occurs during the critical period for LSR when the temperatures are the highest and the stream discharge is the lowest (Figure 6). Due to the low discharge there is less dilution of nutrients in the water column and more available TP for aquatic plant growth. Most of the TP does not correlate with excess sediment during this time period so the dominant form may be organic and consist of organic materials (algae, detritus) and a percentage of dissolved phosphorus.

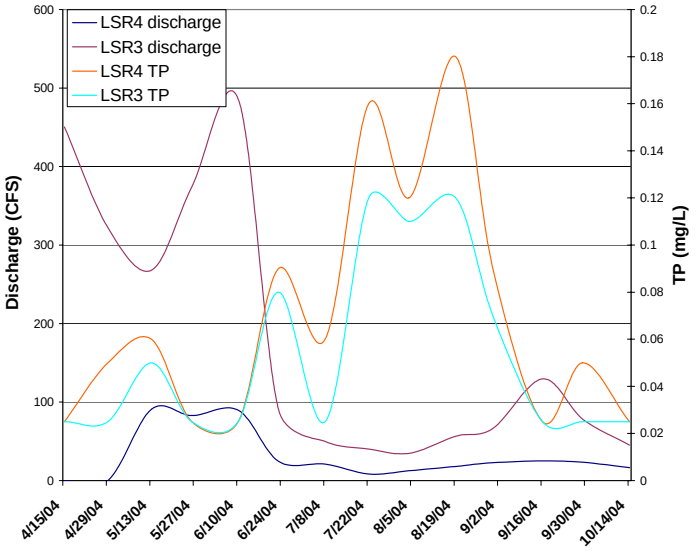

Figure 6. LSR-3 and LSR-4 discharge and TP levels.

Dissolved Oxygen

The state of Idaho has set criteria for the amount of dissolved oxygen (DO) present in a body of water to support cold water biota. Waters designated for cold water biota within the state must have DO levels exceeding six (6) mg/L at all times.

The two lower sites on LSR (Riggins and Whitebird) exhibited DO levels well above the state criteria. LSR-3 (Circle C) and LSR-4 (Old Hwy 95) had DO levels that approached the 6.0 mg/L state criteria but did not drop beneath that level (Figure 7).

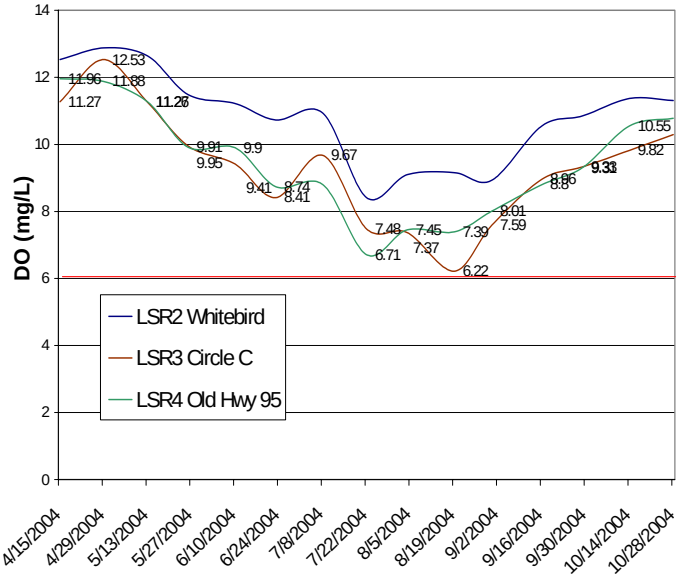

Figure 7. Little Salmon River dissolved oxygen levels.

The lower number at LSR-4 (6.71 mg/L) occurred on July 22, 2004 while the lower number at LSR-3 (6.22 mg/L) occurred on August 19, 2004. These measurements were collected near mid-day (1200 hrs.), which indicates that the actual DO depression may be much lower than 6.0 mg/L during the early hours of sunrise. LSR-3 exhibited large blooms of periphyton that covered the substrate during the month of August. This excessive growth may be the cause of the depressed DO levels. Plants produce oxygen during photosynthesis and consume oxygen at night during respiration. In an aquatic system, a DO deficit concentration may occur if plant respiration is not counter balanced with the production of oxygen.

The upper Big Creek station (BC-2) and lower BC-1 maintained DO levels above the state criteria. One sample from BC-1 showed a slight sag (6.62 mg/L) on July 22, 2004 (Figure 8).

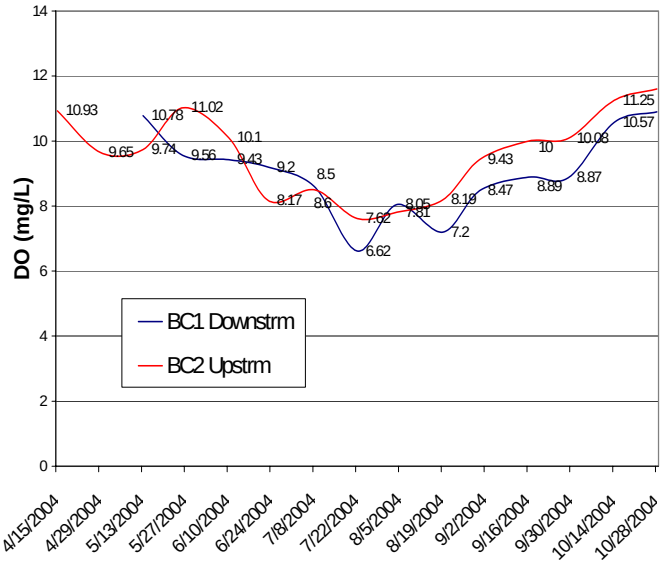

Figure 8. Big Creek dissolved oxygen levels.

It appears the critical period for LSR is when the temperature is increasing the discharge is lower and the TP levels are increasing. This same critical period can also be observed in Figure 9 which depicts the increase of TP with the decline of dissolved oxygen. This is the time period when the water quality at LSR-4 and LSR-3 are vulnerable to unfavorable periphyton blooms and unhealthy DO levels.

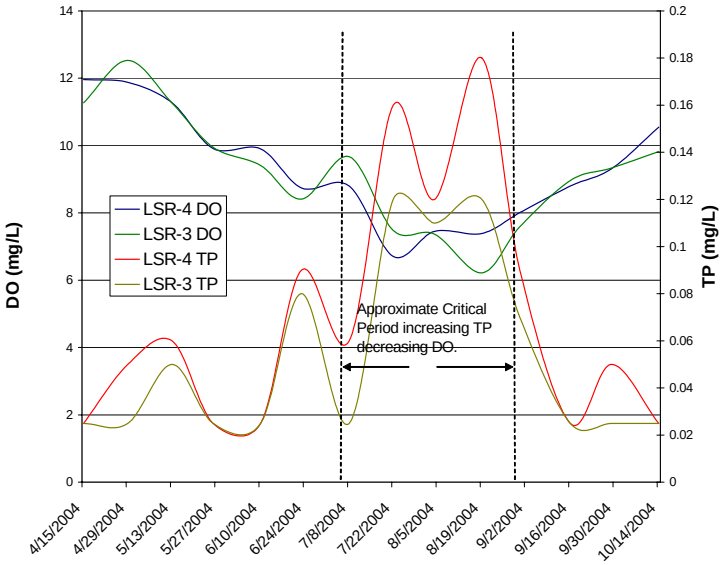

Figure 9. LSR-3 and LSR-4 DO and TP levels.

Bacteria (Escherichia Coli)

ISDA along with IDEQ evaluated bacteria levels within the LSR and BC using the state water quality standard for Escherichia Coli (*E-coli*). The state criteria for *E-coli* (primary contact) is made up of a two step process using a trigger value of 406 colony forming units (CFU) that requires the geomean evaluation of the water body.

The 406 CFU trigger indicates a violation in *E-coli* concentration that requires 5 samples collected over a 30 day period to calculate the monthly geomean for *E-coli*. A geomean concentration over 126 CFU indicates a water quality violation. Table 3 indicates that 3 locations LSR-3, LSR-4 and BC-1 exceeded the state's water quality threshold of 126 CFU for *E-coli*.

Table 3. *E-coli* results geomean concentrations (CFU).

Date	LSR-1	LSR-2	LSR-3	LSR-4	BC-1
6/29/2004	19	41	650	2400	2400
7/8/2004	4	110	200	2400	1400
7/19/2004	71	40	240	1400	2400
7/13/2004	48	8	130	1600	2400
7/22/2004	50	26	260	730	2400
Geomean	**26**	**33**	**254**	**1566**	**2155**

Temperature

Temperature concerns within the LSR are currently being addressed by IDEQ. Measurements collected during this monitoring program were all instantaneous. The state temperature criteria established for cold water biota shall have water quality temperatures of twenty-two (22) degrees Celsius or less with a maximum daily average of no greater than nineteen (19) degrees Celsius. Instantaneous measurements (Table 4) did not exceed twenty-two degree Celsius and there were no daily averages recorded. Although there were no instantaneous values greater than twenty-two degrees, it should be noted that most measurements were not recorded during the heat of the day (late afternoon).

Table 4. Temperature statistics (^{o}C).

Statistics	LSR-2	LSR-3	LSR-4	BC-1	BC-2
Mean	10.4	13	12.7	13.7	13.3
Maximum	16.6	21.2	20.4	20.3	20
Minimum	5.1	5	5.8	4.9	5.1
St. Deviation	4.2	5.9	5	4.9	5.2

Conclusions

Suspended sediment concentrations (SSC) do not appear to be causing any short term acute or long term chronic problems for fisheries within the Little Salmon River. This is not to say that a major sediment transport event did not occur during the sampling period from April through October 2004 but there did not appear to be any chronic effect. It should also be noted that this monitoring program only represented 7% of the possible sampling days during this period.

Data review indicates that there may be a problem with phosphorus concentrations within the upper LSR (meadows area). Algae blooms observed at LSR-3 and depressed DO levels both indicate a possible nutrient enrichment condition. The Environmental Protection Agency's Gold Book (EPA, 1986) recommends that streams not discharging directly into lakes or reservoirs maintain a TP level of 0.10 mg/L or less. LSR-3 and LSR-4 exceeded this level only 3 times during late July through mid August (15% of the samples). These exceedances correlate with the LSR critical period for temperature and low flows. This is also the period when DO levels came close to the minimum state requirement (6.0 mg/L) and heavy periphyton blooms were noted at LSR-3. Big Creek (BC-1) exceeded the 0.10 mg/L target on several occasions (30% of samples) with the highest concentrations correlating with the peak levels recorded at LSR-3 and LSR-4. Additional tributary evaluations in 2005 along with an additional site on LSR may help determine if excessive TP levels are originating within the LSR corridor or from tributary inputs.

E-coli evaluation within the study area indicated that portions of the Little Salmon and Big Creek do not support primary contact due to excessive bacteria levels. LSR-3 (254 CFU), LSR-4 (1566 CFU), and BC-1 (2155 CFU) all exceeded the 126 CFU geomean criteria for *E-coli*. Further evaluation will take place during the 2005 monitoring season to determine a possible source or sources of excessive bacteria loading.

Temperature concerns within the Little Salmon River are currently being evaluated by IDEQ. Using information gathered by various agencies (IDEQ, Idaho Fish and Game, Adams SCD) modeling efforts are currently underway to evaluate temperature fluctuations within the LSR system.

References

Idaho Department of Environmental Quality, IDAPA 58.1.02. Water Quality Standards and Wastewater Treatment Requirements.

United State Geological Survey. Little Salmon River At Riggins ID, http://waterdata.usgs.gov/id/nwis/uv?

USEPA. U.S. EPA. 1986. Quality Criteria for Water. EPA Publication 440/5-86-001. U.S. Gov. Printing Office, Washington DC.

Division of Fisheries and Oceans, Canada, 2000. Effects of sediment on fish and their habitat. DFO Pacific Region Habitat Status Report 2000/01.

Appendix
A

LSR-1 (Riggins Bridge)

Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	
4/15/2004	no sample				no samples			no sample			
4/29/2004	na	na	na	74	38	7.82	1150	6.5	<0.05	<0.05	
5/13/2004	na	na	na	69	37	7.71	1220	5.3	<0.05	<0.05	
5/26/2004	na	na	na	59	31	7.71	1670	4.9	<0.05	<0.05	
6/10/2004	na	na	na	53	26	7.82	2020	7.1	<0.05	<0.05	
6/23/2004	na	na	na	68	37	7.76	995	0.7	<0.05	<0.05	
7/8/2004	na	na	na	100	52	7.84	486	1.4	<0.05	<0.05	NO3
7/22/2004	na	na	na	115	58	7.88	311	2	<0.05	<0.05	<0.2
8/4/2004	na	na	na	132	68	7.97	224	2.5	<0.05	<0.05	<0.2
8/19/2004	na	na	na	140	72	7.99	206	1.4	<0.05	<0.05	3.3
8/31/2004	na	na	na	123	62	7.8	243	1.8	<0.05	<0.05	<0.2
9/16/2004	na	na	na	108	58	7.78	347	2.9	<0.05	<0.05	<0.2
9/29/2004	na	na	na	122	61	7.73	249	1	<0.05	<0.05	<0.2
10/14/2004	na	na	na	132	67	7.75	192	1.8	<0.05	<0.05	<0.2
10/28/2004	na	na	na	122	62	7.59	243	2.3	<0.05	<0.05	<0.2

LSR-2 (Whitebird)

Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	
4/15/2004	12.53	5.3	97.7	64	31	7.96	NA	5.2	<0.05	<0.05	
4/29/2004	12.88	5.1	101.1	47	24	7.74	NA	4.8	<0.05	<0.05	
5/13/2004	12.64	5.3	99.9	45	23	7.63	854	1.7	<0.05	<0.05	
5/26/2004	11.48	8.2	96.8	48	25	7.66	1208	5.1	<0.05	<0.05	
6/10/2004	11.22	9.6	98.9	48	24	7.84	1688	5.1	<0.05	<0.05	
6/23/2004	10.73	12.3	100.7	41	21	7.71	691	<0.3	<0.05	<0.05	
7/8/2004	10.93	12.4	105	82	42	7.92	326	0.9	<0.05	<0.05	NO3
7/22/2004	8.41	16.2	86.3	84	42	7.87	217	0.9	<0.05	<0.05	<0.2
8/4/2004	9.1	16.1	92.3	100	50	7.99	114	0.5	<0.05	<0.05	<0.2
8/19/2004	9.16	16.6	93.6	116	53	8.07	117	1.3	0.06	<0.05	0.5
8/31/2004	8.93	14.9	88.5	88	45	7.92	148.5	1.1	<0.05	<0.05	<0.2
9/16/2004	10.55	11.1	92.7	74	38	7.79	221.3	2.6	<0.05	<0.05	<0.2
9/29/2004	10.85	10.6	97.3	82	41	7.84	163	1.3	<0.05	<0.05	<0.2
10/14/2004	11.37	6.9	93.6	92	46	7.73	93.4	1.1	<0.05	<0.05	<0.2
10/28/2004	11.31	5.9	90.7	83	42	7.56	116.7	1.4	<0.05	<0.05	<0.2

LSR-3 (Circle C)

Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	
4/15/2004	11.27	5	88.5	72	35	7.75	450.3	9.5	<0.05	<0.05	
4/29/2004	12.53	5.8	95.8	67	34	7.57	322.1	5.7	<0.05	<0.05	
5/13/2004	11.26	7.8	93.8	65	33	7.38	268	3.1	0.05	<0.05	
5/26/2004	9.95	9.4	87.1	49	26	7.53	374	8.4	<0.05	<0.05	
6/10/2004	9.41	10.7	85	48	24	7.47	486	7.8	<0.05	<0.05	
6/23/2004	8.41	19.2	89.5	89	42	7.49	90.2	1.4	0.08	<0.05	
7/8/2004	9.67	18	101	123	62	7.91	49.9	0.8	<0.05	<0.05	NO3
7/22/2004	7.48	20.5	83.2	125	63	7.89	40.2	1.1	0.12	<0.05	<0.2
8/4/2004	7.37	21.2	83.2	123	62	8	34.6	1.7	0.11	<0.05	<0.2
8/19/2004	6.22	20.1	68.8	124	63	7.64	56.4	0.3	0.12	0.05	<0.2
8/31/2004	7.59	17.6	81.1	99	50	7.58	66.3	2.2	0.07	<0.05	<0.2
9/16/2004	8.96	12.4	83.2	79	41	7.62	129.7	1.8	<0.05	<0.05	<0.2
9/29/2004	9.33	12.2	87	98	48	7.75	78	0.9	<0.05	<0.05	<0.2
10/14/2004	9.82	8.6	84.5	115	59	7.7	45.2	1.3	<0.05	<0.05	<0.2
10/28/2004	10.29	6.3	83.1	110	56	7.62	56.5	0.8	<0.05	<0.05	0.2

LSR-4 (HWY 95)

Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	
4/15/2004	11.96	5.8	94.3	75	36	**7.67**	NA	8.2	<0.05	<0.05	
4/29/2004	11.88	8.1	100.3	73	38	7.87	NA	5.1	0.05	<0.05	
5/13/2004	11.27	8.7	98.8	83	42	7.73	90.8	2.2	0.06	<0.05	
5/26/2004	9.91	10.6	88.8	83	42	7.37	82.8	5.2	<0.05	<0.05	
6/10/2004	9.9	12.2	92.3	86	43	7.87	89.7	5.6	<0.05	<0.05	
6/23/2004	8.74	18.5	92.7	102	57	7.94	24.5	2.6	0.09	<0.05	
7/8/2004	8.8	16	89	96	48	7.71	21	4.1	0.06	0.05	NO3
7/22/2004	6.71	20.4	74.5	96	48	7.65	8.4	2.4	0.16	0.07	<0.2
8/4/2004	7.45	18.7	79.7	85	43	7.62	12.5	4.4	0.12	0.06	<0.2
8/19/2004	7.39	18.5	78.9	99	50	7.3	18	3.4	0.18	0.1	<0.2
8/31/2004	8.01	16.2	81.7	101	50	7.51	22.8	3.2	0.09	0.05	<0.2
9/16/2004	8.8	12.3	82.3	112	57	7.67	25	1.8	<0.05	<0.05	<0.2
9/29/2004	9.31	11.6	85.6	100	50	7.69	23.3	5	0.05	<0.05	<0.2
10/14/2004	10.55	7.3	87.7	115	59	7.78	16.4	1.8	<0.05	<0.05	<0.2
10/28/2004	10.78	6	86.4	114	57	7.74	20.5	2.3	0.05	<0.05	<0.2

BC-1 Dwnstrm site

Southend Rd.

Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	
5/13/2004	10.78	11.2	98	77	39	7.76	21.2	2.5	0.11	0.06	
5/26/2004	9.56	10.6	85.9	86	43	7.59	20.6	5.6	0.07	<0.05	
6/10/2004	9.43	12.7	88.5	82	42	7.83	20.9	7.2	0.07	<0.05	
6/23/2004	9.2	20.3	101.6	105	53	7.86	5.5	2.9	0.13	0.06	
7/8/2004	8.6	17.1	89	102	52	7.85	10.3	5.3	0.09	0.06	NO3
7/22/2004	6.62	19.3	71.9	87	44	7.39	7.43	5.1	0.13	0.07	<0.2
8/4/2004	8.05	18.9	86.6	81	41	7.53	6.59	3	0.11	0.06	<0.2
8/19/2004	7.2	18	76.3	89	45	7.26	18	0.6	0.18	0.11	<0.2
8/31/2004	8.47	15.3	84.6	84	42	7.46	15.8	6	0.09	0.06	<0.2
9/16/2004	8.89	12.1	82.3	117	59	7.6	10.6	1.8	0.07	<0.05	<0.2
9/29/2004	8.87	11.1	80.4	82	42	7.59	17.2	8.9	0.06	<0.05	<0.2
10/14/2004	10.57	7	87.2	105	53	7.69	9.79	3.4	<0.05	<0.05	<0.2
10/28/2004	10.9	4.9	85.1	102	51	7.89	12.2	3	<0.05	<0.05	<0.2

BC-2 Rane Property Upstrm site

Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	NO3
4/15/2004	10.93	6.5	88.9	75	38	7.98	39.5	5.6	<0.05	<0.05	
4/29/2004	9.65	11.8	88.9	80.8	42	8.19	31.8	1.5	0.05	<0.05	
5/13/2004	9.74	12.2	90.7	89	47	8.04	19.5	4.2	0.05	<0.05	
5/26/2004	11.02	8.8	94.6	90	46	7.83	15.5	3.9	<0.05	<0.05	
6/10/2004	10.1	11.8	93.3	96	48	8.15	20.3	3.7	<0.05	<0.05	
6/23/2004	8.17	19.5	88.9	108	55	8.34	11.2	0.3	<0.05	<0.05	
7/8/2004	8.5	17.8	85	117	59	8.39	7.57	2.3	<0.05	<0.05	
7/22/2004	7.62	19.9	83.7	122	61	8.42	7.42	1.2	<0.05	<0.05	<0.2
8/4/2004	7.81	20	85.6	126	64	8.45	5.25	0.8	0.12	<0.05	<0.2
8/19/2004	8.19	19.4	89.1	134	66	8.51	5.92	0.6	0.06	<0.05	<0.2
8/31/2004	9.43	16	95.2	128	65	8.38	5.77	1.4	0.06	<0.05	<0.2
9/16/2004	10	10.9	90.8	127	65	8.33	5.77	0.8	<0.05	<0.05	<0.2
9/29/2004	10.08	12	93.7	131	63	8.33	5.55	0.3	<0.05	<0.05	<0.2
10/14/2004	11.25	7.4	93.5	130	66	8.26	3.74	0.9	<0.05	<0.05	<0.2
10/28/2004	11.6	5.1	91	129	65	8.12	4.67	0.9	<0.05	<0.05	<0.2